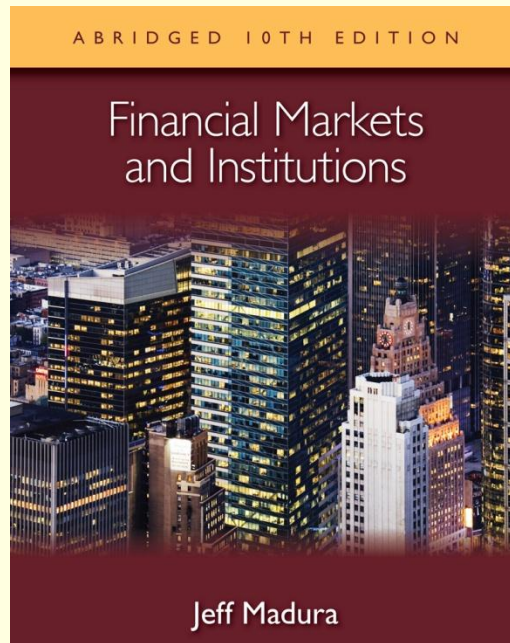


# Financial Markets and Institutions

## Abridged 10<sup>th</sup> Edition

**by Jeff Madura**



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# 3 Structure of Interest Rates

## Chapter Objectives

- describe how characteristics of debt securities cause their yields to vary
- demonstrate how to estimate the appropriate yield for any particular debt security
- explain the theories behind the term structure of interest rates (relationship between the term to maturity and the yield of securities)

# Why Debt Security Yields Vary

The yields on debt securities are affected:

- Credit (default) risk
- Liquidity
- Tax status
- Term to maturity

# Why Debt Security Yields Vary

1. **Credit (Default) Risk** – securities with a higher degree of default risk offer higher yields.
  - a. **Rating Agencies** - Rating agencies charge the issuers of debt securities a fee for assessing default risk. (Exhibit 3.1).
  - b. **Accuracy of Credit Ratings** - The ratings issued by the agencies are useful indicators of default risk but they are opinions, not guarantees.
  - c. **Oversight of Credit Rating Agencies** - The Financial Reform Act of 2010 established an Office of Credit Ratings within the Securities and Exchange Commission in order to regulate credit rating agencies. Rating agencies must establish internal controls.

# Exhibit 3.1 Rating Classification by Rating Agencies

DESCRIPTION OF SECURITY	RATINGS ASSIGNED BY:	
	MOODY'S	STANDARD & POOR'S
Highest quality	Aaa	AAA
High quality	Aa	AA
High-medium quality	A	A
Medium quality	Baa	BBB
Medium-low quality	Ba	BB
Low quality (speculative)	B	B
Poor quality	Caa	CCC
Very poor quality	Ca	CC
Lowest quality (in default)	C	DDD, D

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# Why Debt Securities Yields Vary

**2. Liquidity** - The lower a security's liquidity, the higher the yield preferred by an investor.

**3. Tax Status** (Exhibit 3.2)

- a. Investors are more concerned with after-tax income.
- b. Taxable securities must offer a higher before-tax yield.

**4. Term to Maturity** (Exhibit 3.3)

- a. Maturity dates will differ between debt securities.
- b. The term structure of interest rates defines the relationship between term to maturity and the annualized yield.

# Why Debt Securities Yields Vary

Computing the Equivalent Before-Tax Yield:

$$\gamma_{at} = \gamma_{bt}(1 - T)$$

$\gamma_{at}$  = after-tax yield

$\gamma_{bt}$  = before-tax yield

$T$  = Investor's marginal tax rate

Computing the Equivalent Before-Tax Yield:

$$\gamma_{bt} = \frac{\gamma_{at}}{(1 - T)}$$

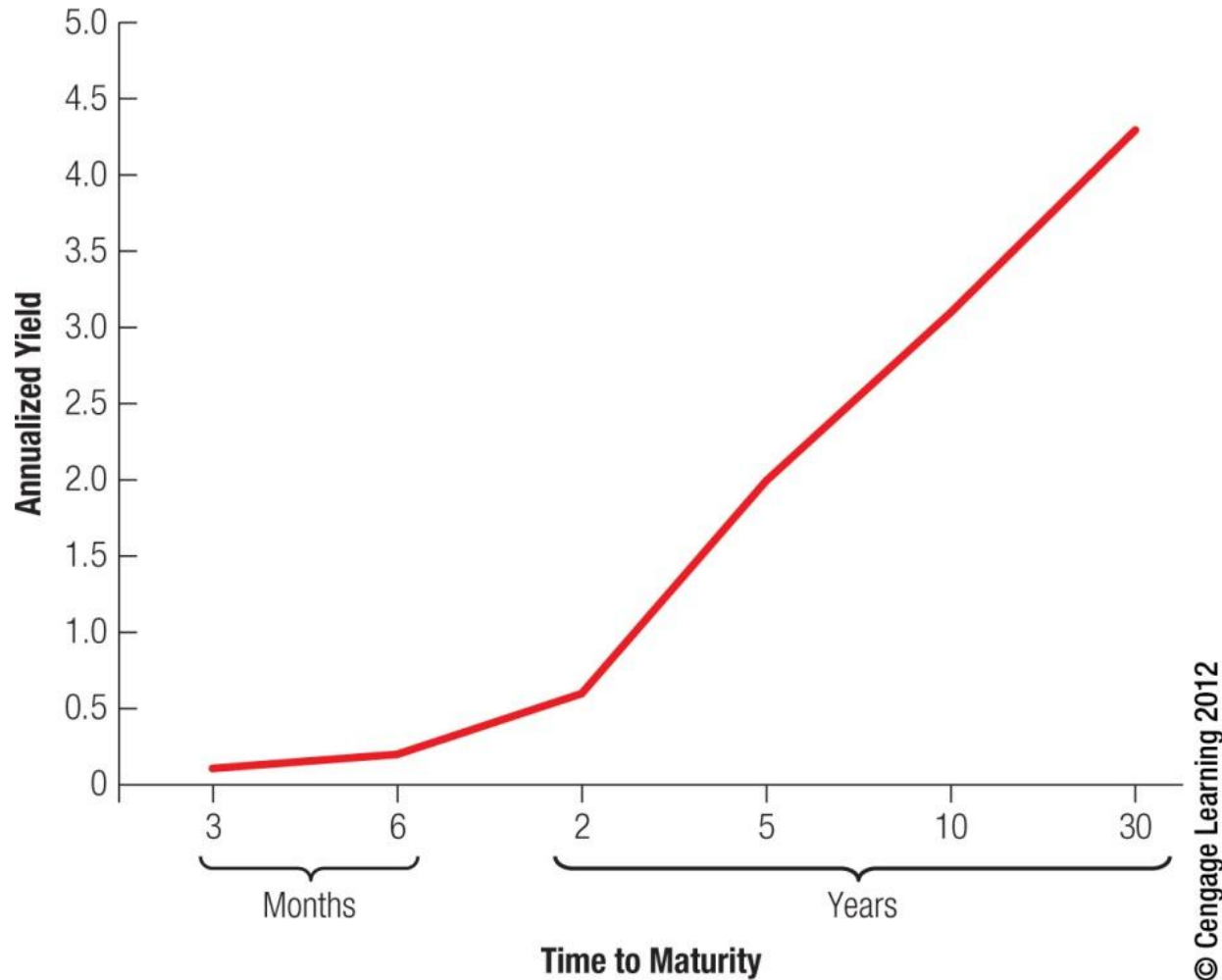
# Exhibit 3.2 After-Tax Yields Based on Various Tax Rates and Before-Tax Yields

TAX RATE	BEFORE-TAX YIELD				
	6%	8%	10%	12%	14%
10%	5.40%	7.20%	9.00%	10.80%	12.60%
15	5.10	6.80	8.50	10.20	11.90
25	4.50	6.00	7.50	9.00	10.50
28	4.32	5.76	7.20	8.64	10.08
35	3.90	5.20	6.50	7.80	9.10

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# Exhibit 3.3 Example of Relationship between Maturity and Yield of Treasury Securities (as of May 2011)



# Explaining Actual Yield Differentials

1. Small yield differentials can be relevant
2. The yield differential is the difference between the yield offered on a security and the yield on the risk-free rate.
3. They are sometimes measured in basis points where  $1\text{bp} = 0.01\%$

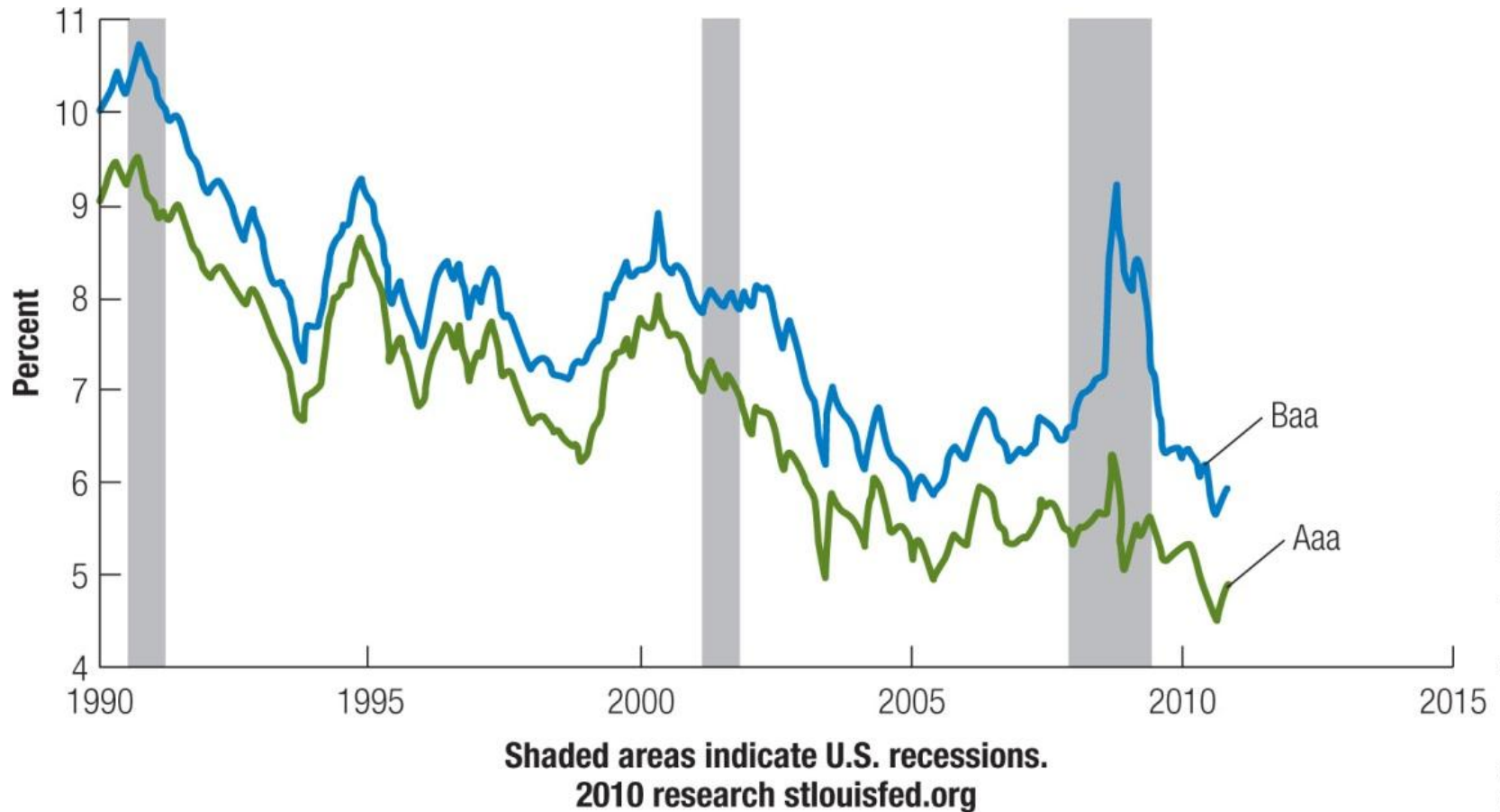
# Yield Differentials on Money Market Securities

1. Yields on commercial paper and negotiable CDs are only slightly higher than T-bill rates to compensate for lower liquidity and higher default risk.
2. Market forces cause the yields on all securities to move in the same direction.

# Yield Differentials on Capital Market Securities

1. Municipal bonds have the lowest before-tax yield but their after-tax yields are typically higher than Treasury bonds.
2. Treasury bonds have the lowest yield because of their low default risk and high liquidity.

# Exhibit 3.4 Yield Differentials of Corporate Bonds



Source: Federal Reserve.

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# Estimating the Appropriate Yield

$$Y_n = R_{f,n} + DP + LP + TA$$

where:

$Y_n$  = yield of an n-day debt security

$R_{f,n}$  = yield of an n-day Treasury (risk-free) security

$DP$  = default premium to compensate for credit risk

$LP$  = liquidity premium to compensate for less liquidity

$TA$  = adjustment due to difference in tax status

# A Closer Look at the Term Structure

1. **Pure Expectations Theory:** Term structure reflected in the shape of the yield curve is determined solely by the expectations of interest rates.
  - a. An **expected increase in rates** leads to an upward sloping yield curve (Exhibit 3.5)
  - b. An **expected decrease in rates** leads to a downward sloping yield curve.

# A Closer Look at the Term Structure

## Algebraic Presentation:

$$(1+_ti_2)^2 = (1+_ti_1)(1+_{t+1}F_1)$$

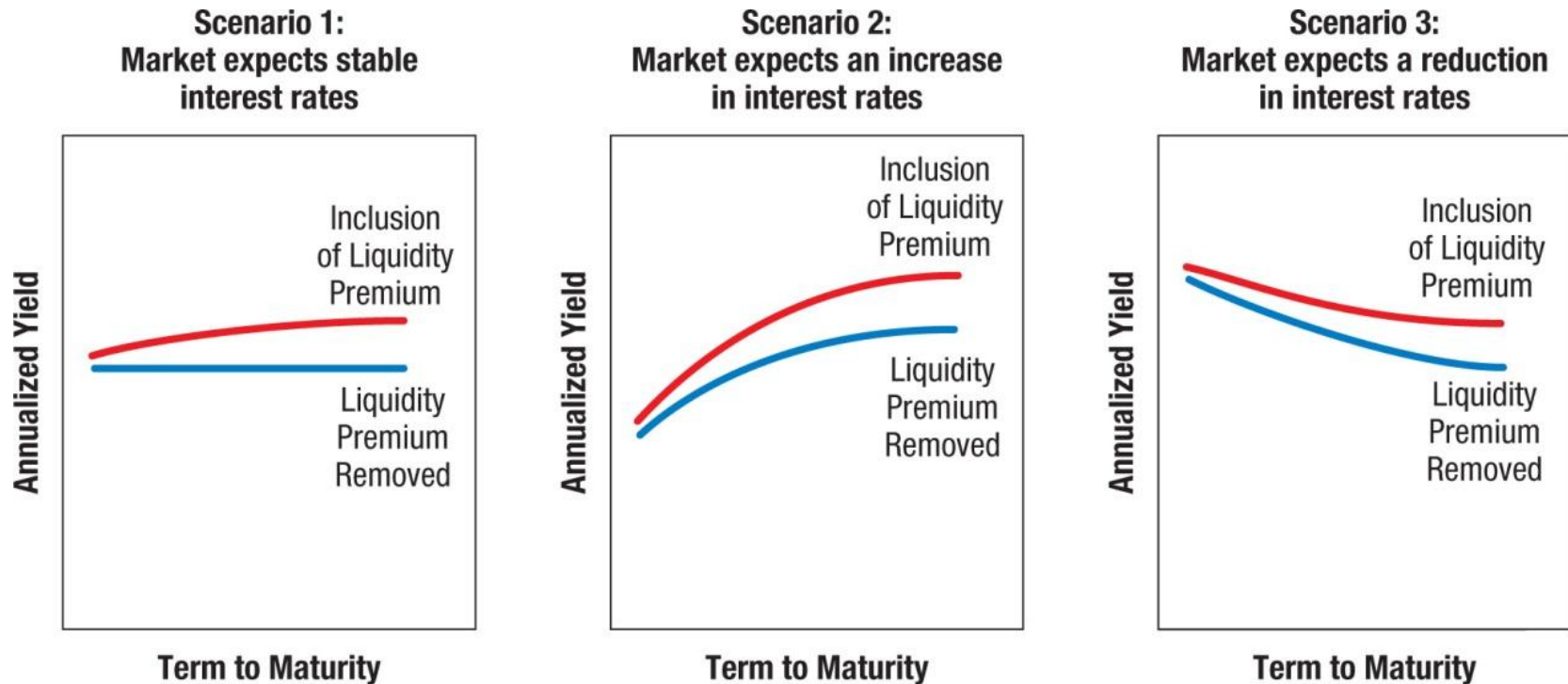
$_ti_2$  = known annualized interest rate of a two - year security at time  $t$

$_ti_1$  = known annualized interest rate of a one - year security at time  $t$

$_{t+1}F_1$  = one - year interest rate that is anticipated as of time  $t + 1$



# Exhibit 3.5 How Interest Rate Expectations Affect the Yield Curve



# A Closer Look at the Term Structure

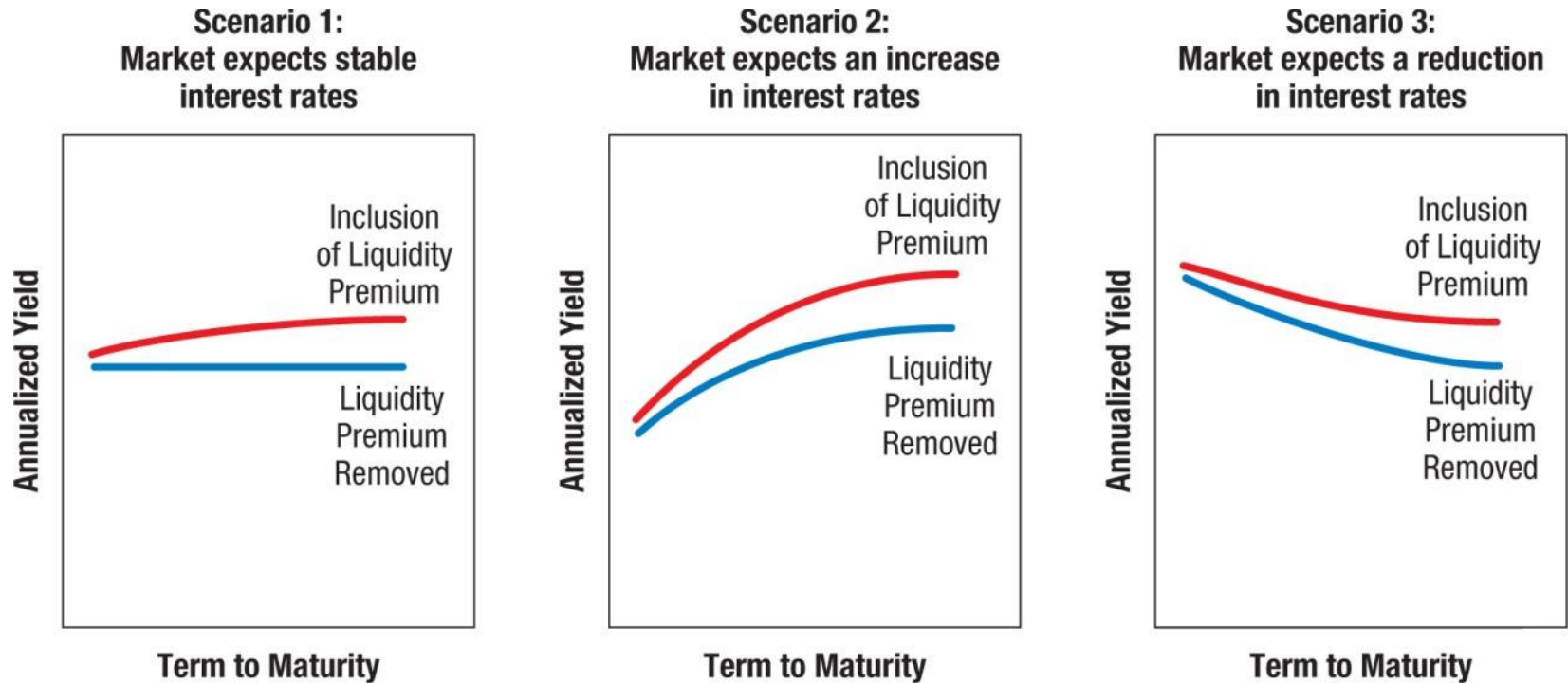
- 2. Liquidity Premium Theory:** Investors prefer short-term liquid securities but will be willing to invest in long-term securities if compensated with a premium for lower liquidity.

## Estimation of Forward Rates Based on Liquidity Premium

$$(1 + {}_t i_2)^2 = (1 + {}_t i_1)(1 + {}_{t+1} r_1) + LP_2$$

where  $LP_2$  is the liquidity premium on the 2 year security

# Exhibit 3.6 Impact of Liquidity Premium on the Yield Curve under Three Different Scenarios



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# A Closer Look at the Term Structure

- 3. Segmented Markets Theory:** Investors choose securities with maturities that satisfy their forecasted cash needs.

## **Limitations of the theory:**

Some borrowers and savers have the flexibility to choose among various maturities

## **Implications: *Preferred Habitat Theory***

Although investors and borrowers may normally concentrate on a particular maturity market, certain events may cause them to wander from their “natural” or preferred market.

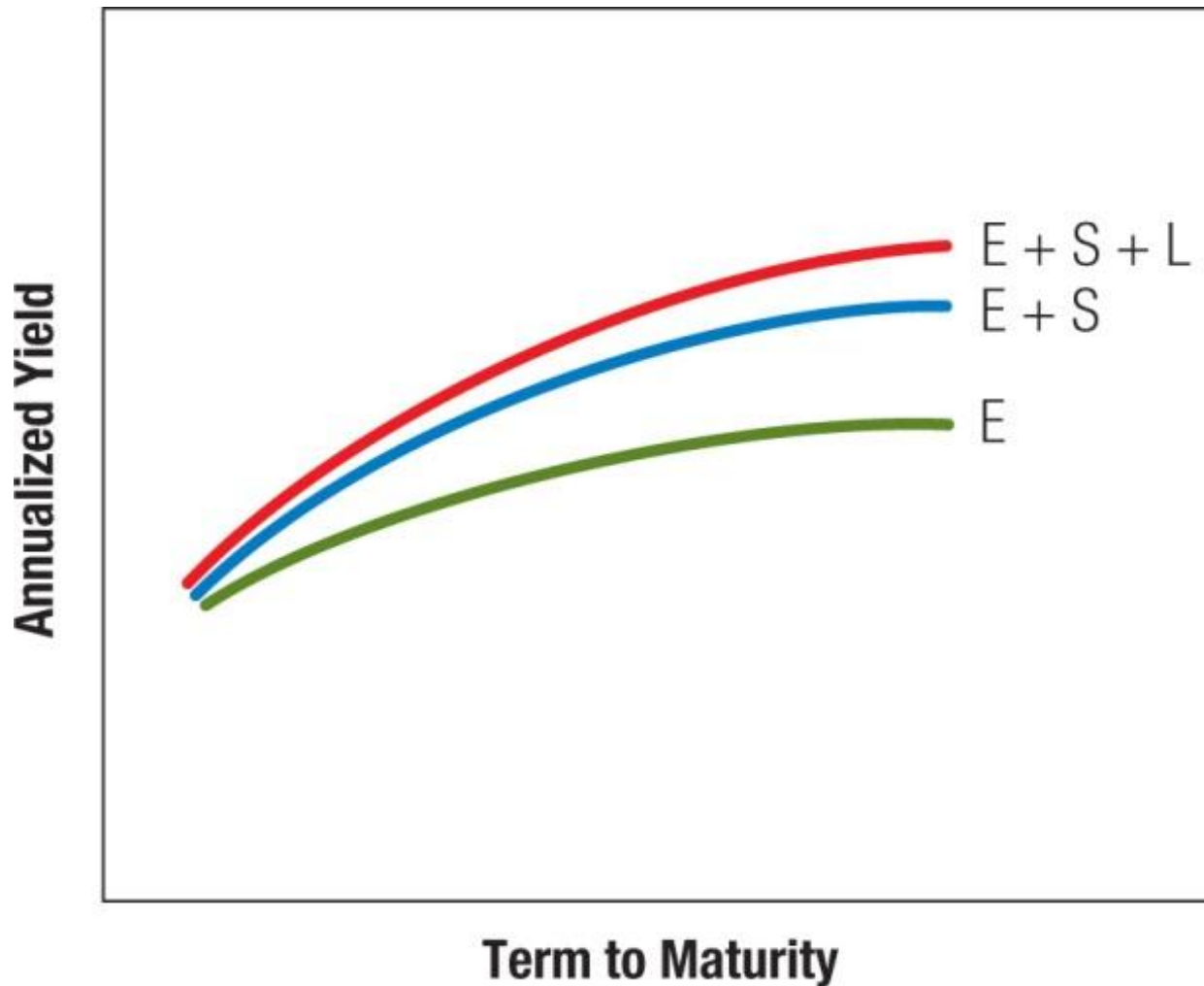
# Research on the Term Structure Theories

1. Interest rate expectations have a strong influence on the term structure of interest rates.
2. However, the forward rate derived from a yield curve does not accurately predict future interest rates, and this suggests that other factors may be relevant.
3. **General Research Implications** - Although the results differ, there is evidence that expectations, liquidity premium, and segmented markets theories all have some validity.

# Integrating the Theories of the Term Structure

1. If we assume the following conditions:
  - a. Investors and borrowers currently expect interest rates to rise.
  - b. Most borrowers need long-term funds, while most investors have only short-term funds to invest.
  - c. Investors prefer more liquidity to less.
2. Then all three conditions place upward pressure on long-term yields relative to short term yields leading to upward sloping yield curve. (Exhibit 3.7)

# Exhibit 3.7 Effect of Conditions in Example of Yield Curve



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# Use of the Term Structure

## 1. Forecasting Interest Rates

- a. The shape of the yield curve can be used to assess the general expectations of investors and borrowers about future interest rates.
- b. The curve's shape should provide a reasonable indication (especially once the liquidity premium effect is accounted for) of the market's expectations about future interest rates.

## 2. Forecasting Recessions - Some analysts believe that flat or inverted yield curves indicate a recession in the near future.



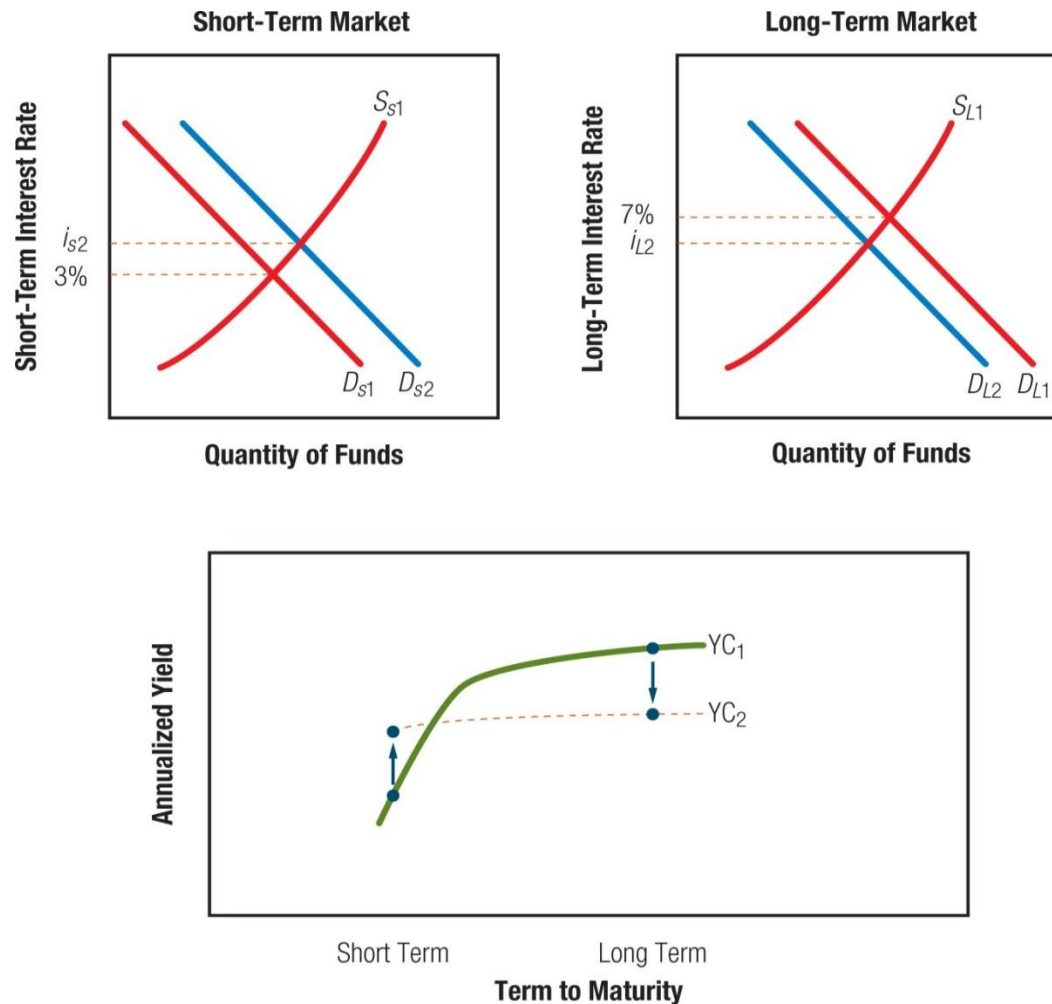
# Use of the Term Structure

- 3. Making Investment Decisions** - If the yield curve is upward sloping, some investors may attempt to benefit from the higher yields on longer-term securities even though they have funds to invest for only a short period of time.
- 4. Making Decisions about Financing** - Firms can estimate the rates to be paid on bonds with different maturities. This may enable them to determine the maturity of the bonds they issue.

# Use of the Term Structure

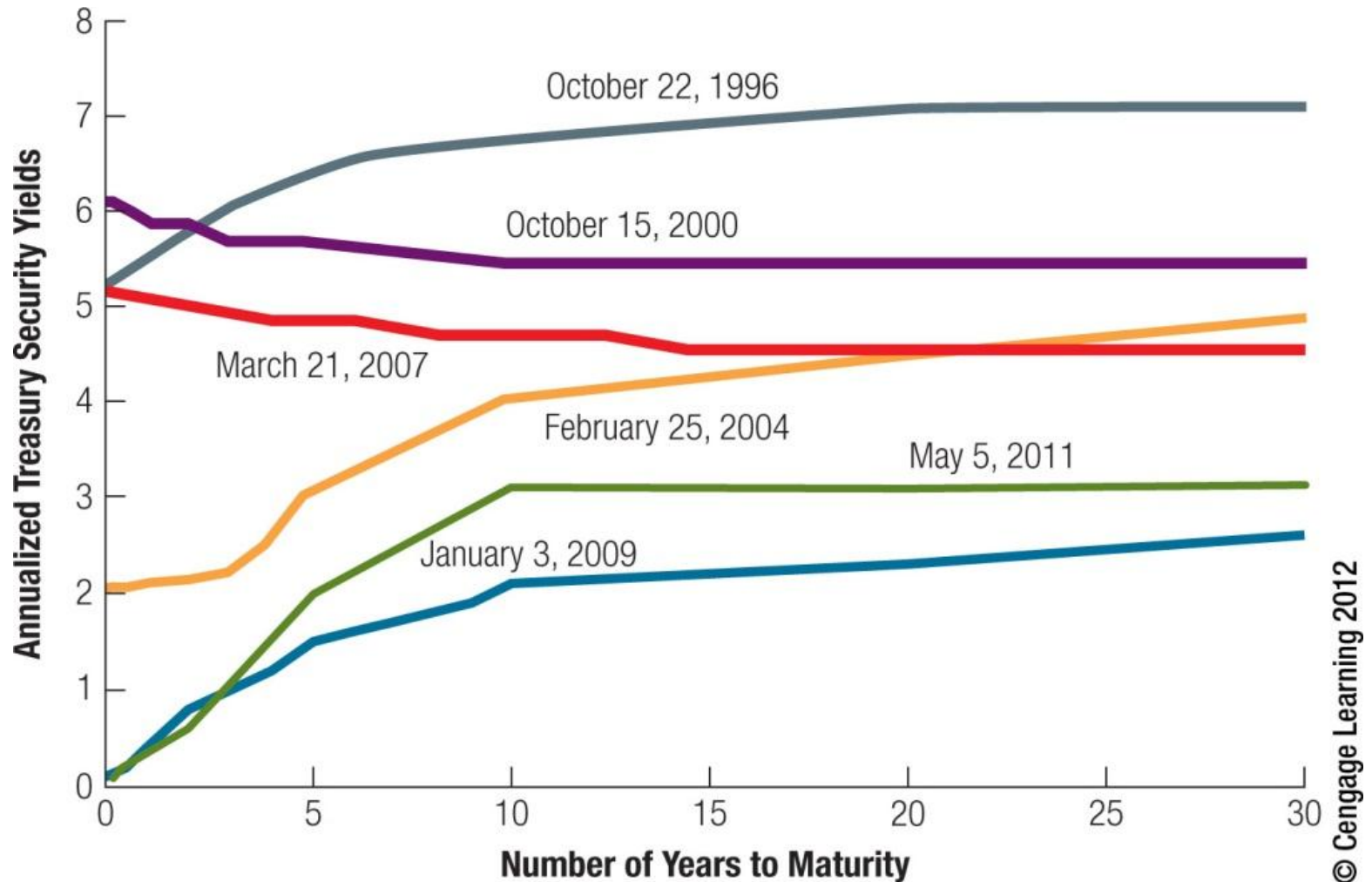
- 1. Why the Slope of the Yield Curve Changes -**  
Conditions may cause short-term yields to change in a manner that differs from the change in long-term yields. (Exhibit 3.8)
- 2. How the Yield Curve Has Changed over Time -**  
Yield curves at various dates are illustrated in Exhibit 3.9.
- 3. International Structure of Interest Rates -** The yield curve's shape at any given time also varies among countries. Exhibit 3.10 plots the yield curve for six different countries in January 2009.

# Exhibit 3.8 Potential Impact of Treasury Shift from Long-Term to Short-Term Financing

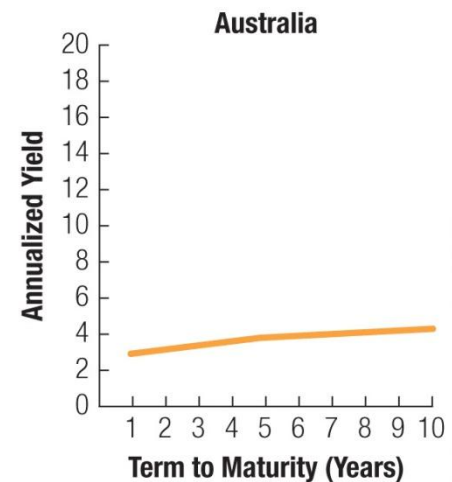
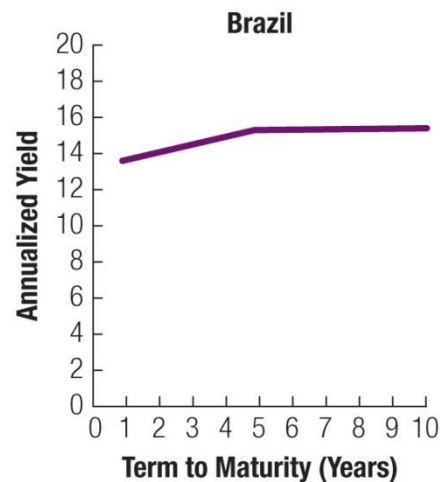
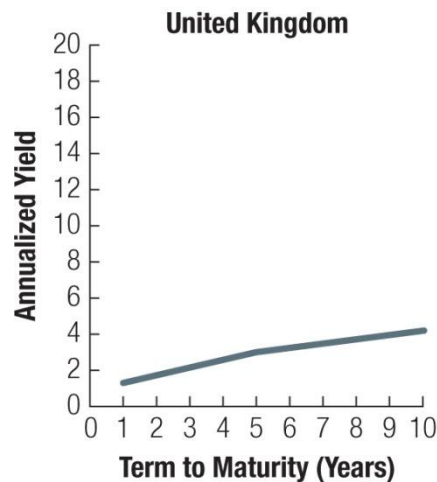
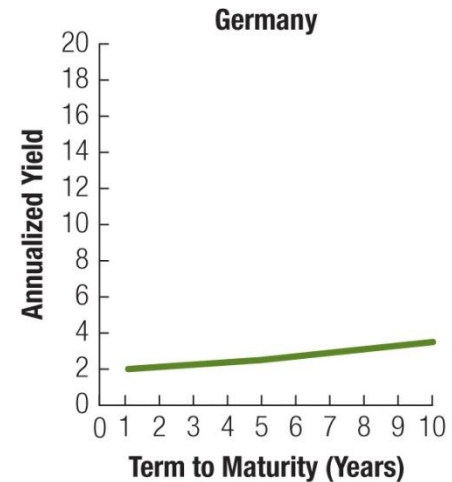
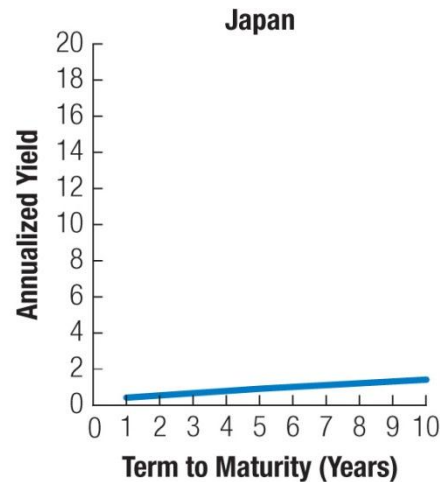
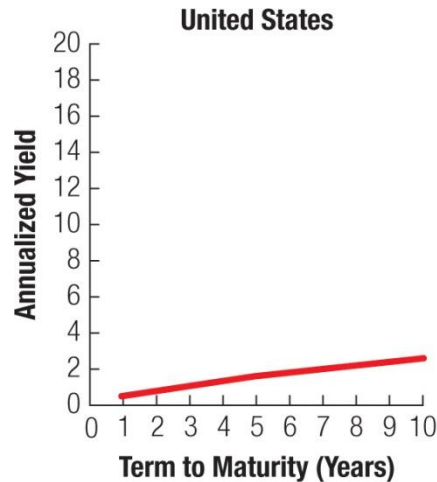


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# Exhibit 3.9 Yield Curves at Various Points in Time



# Exhibit 3.10 Yield Curves among Foreign Countries (as of May 2011)



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# SUMMARY

- Quoted yields of debt securities at any given time may vary for the following reasons. First, securities with higher credit (default) risk must offer a higher yield. Second, securities that are less liquid must offer a higher yield. Third, taxable securities must offer a higher before-tax yield than do tax-exempt securities. Fourth, securities with longer maturities offer a different yield (not consistently higher or lower) than securities with shorter maturities.
- The appropriate yield for any particular debt security can be estimated by first determining the risk-free yield that is currently offered by a Treasury security with a similar maturity. Then adjustments are made that account for credit risk, liquidity, tax status, and other provisions.

# SUMMARY

- The pure expectations theory suggests that the shape of the yield curve is dictated by interest rate expectations. The liquidity premium theory suggests that securities with shorter maturities have greater liquidity and therefore should not have to offer as high a yield as securities with longer terms to maturity. The segmented markets theory suggests that investors and borrowers have different needs that cause the demand and supply conditions to vary across different maturities. Consolidating the theories suggests that the term structure of interest rates depends on interest rate expectations, investor preferences for liquidity, and the unique needs of investors and borrowers in each maturity market.